

Claims

- [c1] 1. An apparatus, comprising:
 - a bit;
 - a plurality of transducers situated on the bit; and
 - an analog multiplexer situated on the on the bit and capable of receiving the output of the transducers, multiplexing the received outputs, and transmitting the multiplexed outputs.
- [c2] 2. The apparatus of claim 1, wherein the bit comprises a roller cone bit or a fixed cutter bit.
- [c3] 3. The apparatus of claim 1, wherein the transducers represent a single type of transducer.
- [c4] 4. The apparatus of claim 3, wherein the single type of transducer is one of a temperature transducer, a strain gauge, an accelerometer, a pressure transducer, a directional transducer, and a wear sensor.
- [c5] 5. The apparatus of claim 1, wherein the transducers represent a plurality of types of transducers.
- [c6] 6. The apparatus of claim 3, wherein the plurality of types of transducer includes at least one of a temperature

transducer, a strain gauge, an accelerometer, a pressure transducer, a directional transducer, and a wear sensor.

[c7] 7.The apparatus of claim 1, further comprising at least one of:
a filter capable of filtering the analog output of the transducers;
a power circuit providing a power signal to at least one of the multiplexer and at least one of the transducers;
a timing circuit capable of providing a timing signal to at least one of the multiplexer and at least one of the transducers; and
transmission circuitry for conditioning the multiplexed data for transmission uphole.

[c8] 8.The apparatus of claim 1, further comprising:
a second plurality of transducers situated on the bit; and
a second analog multiplexer situated on the on the bit and capable of receiving the output of the second plurality of transducers, multiplexing the received outputs of the second plurality of transducers, and transmitting the multiplexed outputs of the second plurality of transducers.

[c9] 9.The apparatus of claim 8, further comprising a third multiplexer receiving the outputs of the first and second multiplexers, multiplexing the received outputs of first

and second multiplexers, and transmitting the multiplexed outputs of the first and second multiplexers.

- [c10] 10. An apparatus, comprising:
 - means for boring through a subsurface formation;
 - means for sensing at least one down-hole drilling condition situated on the boring means and capable of outputting multiple analog signals; and
 - means for multiplexing the analog signals in an analog form and transmitting the multiplexed signals, the multiplexing means being situated on the boring means.
- [c11] 11. The apparatus of claim 10, wherein the boring means comprises a bit.
- [c12] 12. The apparatus of claim 11, wherein the bit comprises a roller cone bit or a fixed cutter bit.
- [c13] 13. The apparatus of claim 10, wherein the sensing means comprises a plurality of transducers.
- [c14] 14. The apparatus of claim 13, wherein the transducers represent a single type of transducer.
- [c15] 15. The apparatus of claim 14, wherein the single type of transducer is one of a temperature transducer, a strain gauge, an accelerometer, a pressure transducer, a directional transducer, and a wear sensor.

- [c16] 16.The apparatus of claim 10, wherein the sensing means comprises a plurality of types of transducers.
- [c17] 17.The apparatus of claim 14, wherein the plurality of types of transducer includes at least one of a temperature transducer, a strain gauge, an accelerometer, a pressure transducer, a directional transducer, and a wear sensor.
- [c18] 18.The apparatus of claim 10, further comprising at least one of:
means for filtering the analog output of the sensing means;
means for powering at least one of the multiplexing means and the sensing means;
means for providing a timing signal to at least one of the multiplexing means and the sensing means; and
means for conditioning the multiplexed data for transmission uphole.
- [c19] 19.The apparatus of claim 10, further comprising:
second means for sensing at least one down-hole drilling condition situated on the boring means and capable of outputting multiple analog signals; and
second means for multiplexing the analog signals of the second sensing means in an analog form and transmit-

ting the multiplexed signals of the of the second sensing means, the second multiplexing means being situated on the boring means.

[c20] 20.The apparatus of claim 19, further comprising third means for multiplexing the outputs of the first and second multiplexing means and transmitting the multiplexed outputs of the first and second multiplexing means.

[c21] 21.A method, comprising:
taking a plurality of measurements of at least one down-hole drilling condition at a bit of a drill string;
generating a plurality of analog signals representative of the measurements; and
multiplexing the analog signals at the bit.

[c22] 22.The method of claim 21, further comprising transmitting the multiplexed analog signals uphole.

[c23] 23.The method of claim 21, wherein taking the plurality of measurements of at least one down-hole drilling condition includes sensing at least one of a temperature, strain on the bit, an acceleration of the bit, a pressure in the borehole, a direction of the bit, and wear on the bit.

[c24] 24.The method of claim 21, further comprising at least one of:

filtering the un-multiplexed analog signals;
powering at least one electronic component situated on the bit;
providing a timing signal to at least one electronic component situated on the bit; and
conditioning the multiplexed data for transmission uphole.

- [c25] 25.The method of claim 21, further comprising:
taking a second plurality of measurements of at least one down-hole drilling condition at the bit;
generating a second plurality of analog signals representative of the second plurality of measurements; and
multiplexing the second plurality of analog signals at the bit.
- [c26] 26.The method of claim 25, further comprising transmitting the multiplexed second plurality of analog signals uphole.
- [c27] 27.The method of claim 25, further comprising multiplexing the first and second multiplexed pluralities of analog signals.
- [c28] 28.The method of claim 27, further comprising transmitting the first and second multiplexed pluralities of analog signals uphole.

- [c29] 29. An apparatus, comprising:
means for taking a plurality of measurements of at least one down-hole drilling condition at a bit of a drill string;
means for generating a plurality of analog signals representative of the measurements; and
means for multiplexing the analog signals at the bit.
- [c30] 30. The apparatus of claim 29, further comprising means for transmitting the multiplexed analog signals uphole.
- [c31] 31. The apparatus of claim 29, wherein means for taking a plurality of measurements the means for taking a plurality of measurements includes means for sensing at least one of a temperature, strain on the bit, an acceleration of the bit, a pressure in the borehole, a direction of the bit, and wear on the bit.
- [c32] 32. The apparatus of claim 29, further comprising at least one of:
means for filtering the un-multiplexed analog signals;
means for powering at least one electronic component situated on the bit;
means for providing a timing signal to at least one electronic component situated on the bit; and
means for conditioning the multiplexed data for transmission uphole.

[c33] 33.The apparatus of claim 29, further comprising:
means for taking a second plurality of measurements of
at least one down-hole drilling condition at the bit;
means for generating a second plurality of analog signals representative of the second plurality of measurements; and
means for multiplexing the second plurality of analog signals at the bit.

[c34] 34.The apparatus of claim 33, further comprising means for transmitting the multiplexed second plurality of analog signals uphole.

[c35] 35.The apparatus of claim 33, further comprising means for multiplexing the first and second multiplexed pluralities of analog signals.

[c36] 36.The apparatus of claim 35, further comprising means for transmitting the first and second multiplexed pluralities of analog signals uphole.